

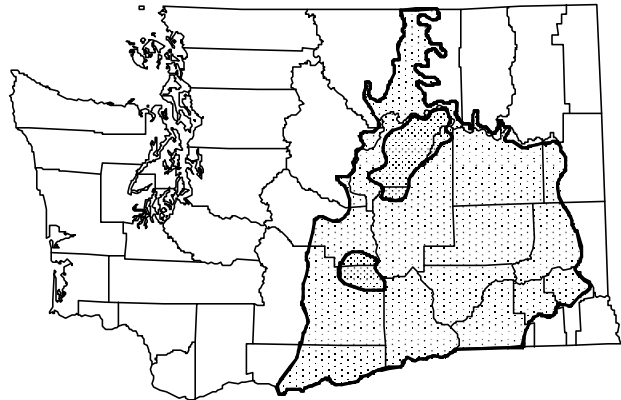
# Washington Department of Fish & Wildlife's Priority Habitat and Species Management Recommendations Volume IV: Birds

## Greater Sage-Grouse *Centrocercus urophasianus*

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### GENERAL RANGE AND WASHINGTON DISTRIBUTION

Greater sage-grouse (*Centrocercus urophasianus*) are closely tied to the distribution of big sagebrush (*Artemisia tridentata*) throughout much of their range (Schroeder et al. 1999). Prior to settlement by people of European descent, sage-grouse were distributed from southern British Columbia, Alberta, and Saskatchewan to eastern California, northern Arizona, and western portions of Oklahoma, Kansas, Nebraska, South Dakota and North Dakota. The core of the distribution was in Washington, Oregon, Nevada, Idaho, Utah, Colorado, Wyoming and Montana. The newly described Gunnison sage-grouse (*Centrocercus minimus*) was found primarily in northwestern New Mexico, southeastern Utah, and southwestern Colorado (Young et al. 2000).



Current (dark) and pre-settlement (light) range of the greater sage-grouse, *Centrocercus urophasianus*, in Washington. Map derived from Schroeder et al. 2000.

Sage-grouse historically occurred throughout the shrub-steppe and meadow-steppe (hereafter referred to collectively as shrub-steppe) communities of eastern Washington (Yocom 1956, Schroeder et al. 2000). They were observed in abundance in 1805 by members of the Lewis and Clark expedition near the confluence of the Columbia and Snake Rivers (Zwickel and Schroeder 2003). Currently, the state has two relatively isolated breeding populations; one in Douglas-Grant

Counties (. 650 grouse), and one in Kittitas-Yakima Counties (. 350 grouse) (M. Schroeder, personal observation). Sporadic sightings outside the primary distribution have been reported in Benton, Yakima, Kittitas, Grant, Lincoln and Okanogan Counties. Sage-grouse management areas are currently being mapped and include portions of Yakima, Kittitas, Benton, Grant, Douglas, Lincoln and Okanogan Counties (Stinson, in preparation; see also Washington Department of Fish and Wildlife 1995).

## RATIONALE

Greater sage-grouse in the state of Washington became a candidate for federal listing as threatened under the Endangered Species Act after a recent petition for listing precipitated a status review (Warren 2001). Although the sage-grouse is classified as a game species in Washington, hunting was terminated in 1988 (Washington Department of Fish and Wildlife 1995); they currently are listed as a state-threatened species (Hays et al. 1998). The distribution of sage-grouse in Washington has been dramatically reduced since pre-settlement times due to the conversion of shrub-steppe to cropland, and the degradation and fragmentation of the remaining habitat (Schroeder et al. 2000). Conserving, restoring and enhancing remaining habitat is critical to the survival of this species (Washington Department of Fish and Wildlife 1995).

## HABITAT REQUIREMENTS

### General Vegetation

Sage-grouse depend on sagebrush (*Artemisia* spp.), primarily big sagebrush, for food and cover throughout the year in Washington (Schroeder et al. 1999). Other important cover species include threetip sagebrush (*Artemisia tripartita*), stiff sagebrush (*Artemisia rigida*), rabbitbrush (*Chrysothamnus* spp.), bitterbrush (*Purshia tridentata*) and gray horsebrush (*Tetradymia canescens*) (Washington Department of Fish and Wildlife 1995). Common grasses and forbs include Sandberg bluegrass (*Poa sandbergii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), needle-and-thread (*Stipa comata*), Indian ricegrass (*Oryzopsis hymenoides*), Idaho fescue (*Festuca idahoensis*), prickly lettuce (*Lactuca serriola*), yellow salsify (*Tragopogon dubius*), milkvetch (*Astragalus* spp.), and microseris (*Microseris* spp.). Relatively dense shrub cover is important during winter and, and a combination of shrub, grass, and forb cover is important during the nesting season (Connelly et al. 2000).

## Breeding Display Grounds (leks)

During spring, males congregate on display sites (leks) to breed with females (Schroeder et al. 1999). Leks are typically located in open areas near relatively dense stands of sagebrush (> 20% canopy coverage) used for food and escape cover (Dalke et al. 1963, Autenrieth 1981, Emmons and Braun 1984, Roberson 1984, Klebenow 1985). In north-central Washington, most documented leks are in wheatfields (M. Schroeder, personal observation). Sage-grouse leks are often located near nesting areas (Wallestad and Pyrah 1974, Berry and Eng 1985, Connelly et al. 1988, Gibson 1996). The typical distance between nests and the nearest leks ranges from 1.3 to 3.4 km (0.8 to 2.1 mi) (Wallestad and Pyrah 1974, Petersen 1980, Autenrieth 1981, Wakkinen et al. 1992, Fischer et al. 1993). In the fragmented shrub-steppe of eastern Washington, the nest-lek distance averages 5.1 km (3.2 mi) (Schroeder 1994). Typical characteristics of productive habitat are 15-25% sagebrush coverage in both arid and mesic (moist) sites; 15% perennial grass/forb cover on arid site; 25% perennial grass/forb cover on mesic sites (Connelly et al. 2000). Grass/forb cover tends to be higher in Washington (Schroeder 1994, Sveum et al. 1998a).

## Nesting and Brood Rearing

Sage-grouse commonly nest in habitat containing sagebrush approximately 30-80 cm (12-31 in) in height, and relatively tall (>20 cm [8 in]), dense (> 40% grass and forb cover) herbaceous cover (Gray 1967, Wallestad and Pyrah 1974, Crawford and DeLong 1993, Gregg et al. 1994, Schroeder 1995, Sveum 1995, Connelly et al. 2000, Livingston and Nyland 2002). Although sage-grouse prefer to nest under sagebrush, they will nest under other plant species (Klebenow 1969, Wallestad and Pyrah 1974, Connelly et al. 1991). Nest success is directly related to higher horizontal and vertical cover at the nest site (Wallestad and Pyrah 1974, Gregg 1991, Connelly et al. 2000). In Washington, sage-grouse select nest sites that contain thicker and taller vegetation as opposed to other regions (Schroeder 1994, Sveum et al. 1998a). At the Yakima Training Center, Livingston and Nyland (2002) found that at the site level, females usually selected shrubs that provided overhead nest concealment and were surrounded by heavy bunchgrass cover >18 cm (7 in) in height.

Broods prefer open sagebrush-dominated habitats with an abundance of insects and succulent forbs (Klebenow 1969, Peterson 1970, Wallestad 1975, Klott and Lindzey 1990, Drut et al. 1994, Sveum et al. 1998b). As plants mature and dry, hens move their broods to habitats with green vegetation such as wet meadows, irrigated farmland or areas at higher elevations (Oakleaf 1971, Connelly et al. 1988, Klott and Lindzey 1990, Fischer et al. 1996, Connelly et al. 2000). Brood habitats in Washington also include areas enrolled in the federal Conservation Reserve Program (Conservation Reserve Program unpublished data).

## Winter

Sagebrush provides escape cover and a majority of the dietary requirements for sage-grouse in winter (Connelly et al. 2000). They prefer sagebrush 25 cm (10 in) high above the ground or snow, with 10-30% canopy coverage (Eng and Schladweiler 1972, Wallestad and Schladweiler 1974, Wallestad 1975, Autenrieth 1981, Connelly et al. 2000). Good wintering areas are found at a variety of elevations, and include windswept ridges and sagebrush flats (Eng and Schladweiler 1972, Wallestad and Schladweiler 1974, Wallestad 1975, Autenrieth 1981). Winter habitat selection is often dependent on snow-depth (Hays et al. 1998). During winter, Robertson (1991) reported that migratory sage-grouse in southeastern Idaho made average daily movements of 752 m (2467 ft) and occupied an area >140 km<sup>2</sup> (54 mi<sup>2</sup>). Wallestad (1975) reported that winter home range size varied between 11 and 31 km<sup>2</sup> (4-12 mi<sup>2</sup>) in Montana.

## Food

Sagebrush is a crucial component of the sage-grouse diet year-round, particularly during late autumn, winter and early spring (Remington 1983, Remington and Braun 1985, Welch et al. 1988, 1991; Myers 1992). Forbs are important food items for sage-grouse during spring, summer and early autumn; especially for hens prior to egg laying (Wallestad et al. 1975, Barnett and Crawford 1994, Drut et al. 1994). Pre-laying hens require a diet of forbs rich in calcium, phosphorus and protein in order to produce healthy clutches (Barnett and Crawford 1994). Thus, the condition of breeding habitats used by pre-laying hens plays an important role in overall reproductive success (Barnett and Crawford 1994, Coggins 1998).

Broods feed heavily on insects during their first weeks of life (Klebenow and Gray 1968, Peterson 1970, Johnson and Boyce 1990, Drut et al. 1994, Pyle and Crawford 1996). As chicks grow, they eat more forbs, gradually switching to a diet that consists primarily of forbs (Peterson 1970). Forbs consumed include desert parsley (*Lomatium* spp.), hawksbeard (*Crepis* spp.), prickly lettuce, common dandelion (*Taraxacum officinale*), mountain dandelion (*Agoseris* spp.), western yarrow (*Achillea millefolium*), pale agoseris (*Agoseris glauca*), clover (*Trifolium* spp.), yellow salsify, everlasting (*Antennaria* spp.), vetch (*Vicia* spp.), milkvetch, alfalfa (*Medicago sativa*), aster (*Aster* spp.) and long-leaf phlox (*Phlox longifolia*) (Wallestad et al. 1975, Drut et al. 1994, Barnett and Crawford 1994). The availability of forbs and insects influences sage-grouse chick survival (Johnson and Boyce 1991).

## LIMITING FACTORS

In Washington, the lack of extensive good quality shrub-steppe vegetation limits sage-grouse (Washington Department of Fish and Wildlife 1995, Hays et al. 1998, Schroeder et al. 2000). Habitat loss, degradation and fragmentation of shrub-steppe can be attributed to land conversion, development, grazing, sagebrush removal and burning, erosion, mining, military activity, noise, power lines and roads (Klebenow 1972, Braun 1986, Swenson et al. 1987, Hofmann 1991,

Remington and Braun 1991, Washington Department of Fish and Wildlife 1995, Schroeder et al. 2000).

## MANAGEMENT RECOMMENDATIONS

### Conversion of Shrub-Steppe

The reduction in sage-grouse numbers and distribution is primarily attributed to the loss, fragmentation, and degradation of shrub-steppe habitat through land conversion and mismanagement (Braun 1998). Most of the remaining shrub-steppe habitats are characterized by relatively shallow soil; hence they are usually undesirable for crop production (Dobler et al. 1996, Jacobson and Snyder 2000, Vander Haegen et al. 2000). Nevertheless, further conversion of shrub-steppe habitat within sage-grouse management areas should be strongly discouraged (Washington Department of Fish and Wildlife 1995). Despite the importance of shrub-steppe to many declining Species of Concern, conversion of shrub-steppe habitat on public and private lands is continuing (Hays et al. 1998). Conservation of shrub-steppe habitat in and around croplands in Douglas County is also extremely important because these sites are a source of sagebrush seed that germinate on the extensive lands that are enrolled in the Federal Conservation Reserve Program in this county (Hays et al. 1998).

### Sagebrush Alteration

Removal or alteration of sagebrush should be avoided within sage-grouse management areas, particularly near leks, brood-rearing and in nesting and wintering areas (Connelly et al. 2000). Sage-grouse depend upon sagebrush stands for most of their life needs throughout the year, therefore sagebrush should not be eradicated (Connelly et al. 2000). Sagebrush should not be removed within 300 m (984 ft) of sage-grouse foraging sites along riparian areas, meadows, lake beds, and farmlands (Connelly et al. 2000). Sagebrush removal should not occur where live sagebrush cover is <25% in nesting areas, and <30% in wintering areas (Connelly et al. 2000). Sagebrush should also not be controlled on slopes >20% and/or on slopes with shallow soils where big sagebrush is <30 cm (12 in) in height (Call and Maser 1985). Anyone planning to remove sagebrush should carefully consider the method of removal (fire, mechanical means, herbicides), amount removed, species removed, post-removal management, mitigation measures, and the effects on the sage-grouse population (see references in contact section for assistance).

## Fire

Wildfires pose a substantial threat to sage-grouse in Washington and occupied habitat should be a high priority for fire suppression and prevention (Connelly et al. 2000). Prescribed fire has been used to reduce sagebrush that in turn increases grass and forb cover (Pyle and Crawford 1996). However, Wambolt et al. (2002) pointed out that there is no empirical evidence demonstrating the benefits of fire to sage-grouse.

Where fire is used as a management tool to restore potential habitat, controlled burns are recommended in late April to early May when fuels left from the prior growing season are able to carry a relatively cool fire (Autenrieth 1981). These prescribed fires should be # 50 ha in size and cover less than 20% of an area used by sage grouse during winter within any 20–30 year interval (depending on estimated recovery time for the sagebrush habitat) (Connelly et al. 2000). Because the availability of critical wintering habitat is likely the most significant limiting influence on sage-grouse, any burning conducted in wintering habitat should only be done with extreme caution as a means to restore habitat, and only very small portions of wintering habitat should be burned during any given season (Connelly et al. 2000). Avoid using fire without including plans to control cheatgrass competition in the understory (e.g., through the use of a pre-emergent herbicide [e.g., Oust®, Plateau®]) where an increase of or an invasion by cheatgrass (*Bromus tectorum*) is likely (Connelly et al. 2000). Annual grassland establishment following fire is very detrimental to sagebrush habitat integrity (Young and Longland 1996). In addition, habitat recovery following a fire may require several decades before sagebrush regrowth is sufficient to support sage-grouse (Connelly et al. 2000). Changes in livestock management (e.g., exclusion, change in season and/or intensity of use) following planned burns and wildfires is essential to the reestablishment of native shrubs and forbs (Beck and Mitchell 2000).

Fire should not be used in breeding habitat dominated by Wyoming big sagebrush (Connelly et al. 2000). Controlled burning should not be considered for any type of sage-grouse habitat unless the action is part of a carefully considered overall plan to restore shrub-steppe habitat and the likelihood of beneficial results for the species is high (Washington Department of Fish and Wildlife 1995).

## Grazing and Browsing

Livestock grazing has been a common use of shrub-steppe lands within the range of sage-grouse in Washington (Hays et al. 1998). Although it is difficult to document positive effects of livestock grazing on sage-grouse, the existence of healthy sage-grouse populations in areas long grazed suggests that certain grazing levels may be compatible with sage-grouse populations (Wambolt et al. 2002). Vegetation characteristics of sage-grouse breeding, brood-rearing, and winter habitats (Table 1) should be used as guidelines in developing livestock grazing management plans, but these plans should also consider the long-term sustainability of the habitat, the likelihood of drought, and the potential for expansion of noxious weeds.

Light grazing in sage-grouse habitat should be managed for optimum growth and reproduction of native sagebrush, forbs and grasses (Table 1) (Beck and Mitchell 2000). The type and stocking rates of livestock, season of use, and grazing duration should be carefully planned based on available forage resources, and monitored on a site specific basis, with the goal of providing optimal sage-grouse habitat (Beck and Mitchell 2000) and long-term sustainability. This is particularly important in nesting areas, where sage-grouse are dependent on residual cover for concealment from predators. During drought periods (2 consecutive years), it may be necessary to reduce stocking rates or change livestock management practices if herbaceous height requirements for cover (Table 1) during the nesting and brood-rearing periods are not met (Gregg et al. 1994, Sveum 1995, Connelly et al. 2000, Livingston and Nyland 2002).

Biological soil crusts are a common feature of many shrub-steppe plant communities, particularly in the lowest precipitation zones (Belnap et al. 2001). Biological crusts are comprised of lichens, mosses, cyanobacteria, green algae, microfungi, and other bacteria that might indirectly benefit grouse through aiding nitrogen fixation of plants, increasing the nutrient value of plants, increasing native plant germination rates, and by inhibiting the expansion of exotic species including cheatgrass (Belnap et al. 2001; J. Belnap, personal communication). These organisms form a living soil crust that is easily damaged by livestock grazing (Daubenmire 1940, Mack and Thompson 1982, Belnap et al. 2001). Belnap et al. (2001) describes grazing practices that can help reduce damage to biological soil crusts. Although most soil crust studies were conducted in more arid environments, precipitation levels in some of these studies rival the drier areas of eastern Washington. Research is needed to fully understand the ecological function, impacts of disturbance, and the means to reduce impacts to biological crusts in eastern Washington's shrub-steppe.

Table 1. Characteristics of sagebrush communities needed for productive sage-grouse habitat (Connelly et al. 2000).

	Breeding		Brood-rearing		Winter <sup>e</sup>	
	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)
Mesic (moist) sites <sup>a</sup>						
Sagebrush	40 – 80	15 – 25	40 – 80	10 – 25	25 – 35	10 – 30
Grass-forb	> 18 <sup>c</sup>	≥ 25 <sup>d</sup>	variable	> 15	N/A	N/A
Arid sites <sup>a</sup>						
Sagebrush	30 – 80	15 – 25	40 – 80	10 – 25	25 – 35	10 – 30
Grass-forb	> 18 <sup>c</sup>	≥ 15 <sup>d</sup>	variable	> 15	N/A	N/A
Area <sup>b</sup>	> 80		> 40		> 80	
Approximate period of use	late winter – late spring		late spring – early autumn		autumn – late winter	
General characteristics	Open areas surrounded by sagebrush.		Open sagebrush-dominated habitats with an abundance of insects/succulent forbs.		Areas that allow sagebrush access under various snow conditions.	

a. Mesic and arid sites should be defined on a local basis; annual precipitation, herbaceous understory, and soils should be considered (Tisdale and Hironaka 1981, Hironaka et al. 1983).

b. Percentage of seasonal habitat needed with indicated conditions.

c. Measured as “droop height”; the highest naturally growing portion of the plant.

d. Coverage should exceed 15% for perennial grasses and 10% for forbs; values should be substantially greater if most sagebrush has a growth form that provides little lateral cover (Schroeder 1995).

e. Values for height and canopy coverage are for shrubs exposed above snow.

Wild (as well as domestic) herbivores can significantly influence and alter plant community composition and structure to varying degrees among different ecosystems (Augustine and McNaughton 1998, Opperman and Merenlender 2000). The forbs and bunchgrasses native to shrub-steppe in Washington are not tolerant to intensive and prolonged grazing because large grazing animals were presumably not present in large numbers for several thousand years prior to the introduction of domestic livestock (Mack and Thompson 1982, Lyman and Wolverton 2002). In some instances, the exposure of sagebrush communities to deer (*Odocoileus* spp.) and elk (*Cervus elaphus*) browsing can suppress the production, germination and survival of sagebrush and increase the production of annual plant species (McArthur et al. 1988, Singer and Renkin 1995), potentially influencing grouse habitat. If necessary, wildlife resource agencies may consider means of reducing the impacts of wild ungulates on grouse habitat that might include altering supplemental feeding programs, adjusting hunting regulations, and temporary fencing.

The effects of livestock grazing on shrub-steppe vegetation largely depend on the timing, frequency, and intensity of grazing. Over-grazing (i.e., repeated grazing that exceeds the recovery capacity of the vegetation and creates or perpetuates a deteriorated plant community) should be discouraged within sage-grouse management areas (Washington Department of Fish and Wildlife 1995, Beck and Mitchell 2000, Connelly et al. 2000). Frequent heavy grazing (i.e., removal of >50% of current year’s growth) deteriorates the species composition and structure of native plant



communities (Holechek et al. 1999). Although light grazing of healthy shrub-steppe may not cause habitat degradation (Klebenow 1981, Call and Maser 1985, Beck and Mitchell 2000), the intensity of grazing that is tolerable is not clear, but may be #25% utilization of the current year's growth of key forage species (Galt et al. 2000, Holechek et al. 2003). It is especially important that this level of grazing not be exceeded in areas where habitat restoration and maintenance is the objective (Galt et al. 2000), during drought years (Holechek et al. 2003), and/or following fires (Beck and Mitchell 2000). When habitat is degraded by over-grazing, recovery of the native plant community likely requires a dramatic reduction (if not a cessation) of grazing for a long period of time (Anderson and Inouye 2001). However, restoring severely altered habitat (e.g., area devoid of its native species and seed sources) often requires more than simply removing cattle to recover the native plant community (Bunting et al. 2002).

## Chemical Treatments

Herbicides may be necessary to improve sage-grouse habitat where noxious weeds have replaced native vegetation (Washington Department of Fish and Wildlife 1995). Herbicide application should be followed with restoration efforts designed to enhance native vegetation or establish a desirable plant community. The herbicide 2,4-D should not be used for sagebrush control because its application results in a significant loss of native forbs (Call and Maser 1985). Tebuthiuron (e.g., Spike®) should not be used, except in small scale experiments, until it is demonstrated that it has no long-lasting impacts to sage-grouse habitat (Connelly et al. 2000).

Insecticides should not be applied to sage-grouse summer habitat, particularly organophosphorus and carbamate insecticides, which are highly toxic (Blus et al. 1989). Insects are the primary food source for young sage-grouse chicks, and insecticide use can be directly and indirectly detrimental to sage-grouse (Beck and Mitchell 2000).

Land managers should be encouraged to use integrated pest management that targets specific pests or noxious weeds, to use pest population thresholds to determine when to use pesticides or herbicides, and to use crop rotation/diversity and beneficial insects to control pests (Stinson and Bromley 1991). For more information on alternatives such as integrated pest management, contact your county Washington State University Cooperative Extension Service or the USDA Natural Resource Conservation Service.

## Human Disturbance

Disturbances should be minimized from mid-February through early June within breeding and nesting areas (Hofmann 1991). Although nesting areas have been generally defined as locations within 3.2 km (2 mi) of leks, recent studies suggest that many nests are >3 km (2 mi) from leks (Wallestad and Pyrah 1974, Autenrieth 1981, Connelly et al. 1988, Eberhardt and Hofmann 1991, Wakkinen et al. 1992, Schroeder 1994).

Viewing and censusing sage-grouse leks should be conducted in a way that avoids disturbing the birds (Call and Maser 1985). Agencies should not provide lek locations to people who wish to view birds without supervision (Connelly et al. 2000). If public interest in viewing leks is high, agencies should consider constructing viewing blinds at specific locations for public use (Connelly et al. 2000). Camping on or near active leks should not be permitted (Connelly et al. 2000). On the Yakima Training Center, vehicle activity has been shown to disturb sage-grouse in critical areas (e.g., leks) (Hays et al. 1998). Therefore, activity on roads traversing sage-grouse leks should be restricted during hours when birds are active (sunset - 3 hours after sunrise) during the lekking season.

Fences, utility wires, and other structures can be hazardous to flying grouse. New and existing fences should be made more visible with flagging or by other means, within 1 km (0.6 mi) of sage-grouse habitat (Connelly et al. 2000). Woven wire fences negatively influence sage-grouse because they cannot quickly fly or travel through them (Braun 1998). Utility wires can also create hazards for sage-grouse (Borell 1939). Wind turbines should not be located in habitat known to be occupied by sage-grouse because this species avoids vertical structures and is sensitive to habitat fragmentation (U.S. Fish and Wildlife Service 2003). In grouse habitat, avoid placing turbines within 8 km (5 mi) of known leks (U.S. Fish and Wildlife Service 2003). The expansion of roads near shrub-steppe habitat used by grouse leads to habitat loss and fragmentation, direct mortality (Braun 1998), and the spread of invasive weeds. Consequently, limitations should be placed on the expansion of roads within grouse habitat.

## Predation

The establishment of red fox and other non-native predators should be prevented in sage-grouse habitat (Connelly et al. 2000). Avoid building tall structures that provide raptor perch sites, such as utility structures, within 3 km (1.9 mi) of sage-grouse habitat. If structures are unavoidable or already exist, they should be modified to discourage raptors from perching on them (Connelly et al. 2000). Raptor-proofing techniques might include, but are not limited to placing power-lines underground, covering horizontal surfaces (e.g., ledges) and other structures with steeply angled slanting boards or sheets metal or placing low-voltage, electrically charged wires over perching structures. Fences with adjacent pathways (e.g., trails, roads) negatively impact sage-grouse because they provide travel corridors for potential predators (Braun 1998). Additionally, fences with wood posts provide perch sites for potential avian predators (Braun 1998).

Habitat alteration associated with grazing, drought, and wildfire may increase the rate of predation

on juveniles, but this relationship is unclear and predation has not been identified as a major limiting factor for sage-grouse (Gregg et al. 1994, Connelly and Braun 1997, Schroeder and Baydack 2001). In general, management that retains or produces good quality grouse habitat should be used as the most cost-effective tool for minimizing the negative effects of predation (Schroeder and Baydack 2001).

## Conservation and Restoration

Restoration of degraded shrub-steppe is a priority (Washington Department of Fish and Wildlife 1995). Efforts to restore depleted or converted habitat should concentrate on reestablishing locally adapted, native shrub-steppe vegetation (Connelly et al. 2000) and reducing grazing pressure when necessary (Beck and Mitchell 2000). Where introduced species are the only available alternative, use species that mimic the structural characteristics of the native species and that provide food (Connelly et al. 2000). Seeding of areas with highly competitive and structurally dissimilar species such as crested wheatgrass (*Agropyron cristatum* or *Agropyron desertorum*), intermediate wheatgrass (*Agropyron intermedium*), pubescent wheatgrass (*Agropyron trichophorum*), or smooth brome (*Bromus intermis*) should be discouraged (Beck and Mitchell 2000, Connelly et al. 2000, A. Sands, personal communication). Habitats that have been degraded should be managed to promote habitat recovery. Areas that possess an understory of native forbs and bunchgrasses prior to wildfire may not need re-seeding (M. Livingston, personal communication). However, sagebrush seeding might be necessary depending on fire size and intensity as well as the distance to seed sources.

Agricultural set-aside programs (such as the Conservation Reserve Program and the Wetlands Reserve Program) and other types of voluntary conservation incentive programs (e.g., Candidate Conservation Agreements, Partners for Fish and Wildlife) should be encouraged in sage-grouse management areas in Washington (Washington Department of Fish and Wildlife 1995). Set-aside conservation programs should be structured to encourage enrollees to plant a diverse range of perennial shrubs, grasses, and forbs and to retain annual residual cover (Hays et al 1998).

Local and regional government programs should be reviewed to ensure they address long-term conservation of sage-grouse populations and habitat. Specifically, critical areas protection that falls under Washington's Growth Management Act are intended to protect State-listed species and can be an effective conservation tool. Local development regulations could require mitigation standards and provide incentives to reduce impacts from projects that potentially affect sage-grouse habitat. Many resource agencies, including Washington Department of Fish and Wildlife, have staff that can provide assistance in critical areas planning.

## REFERENCES

- Anderson, J. E., and R. S. Inouye. 2001. Landscape-scale changes in plant species abundance and biodiversity of a sagebrush steppe over 45 years. *Ecological Monographs* 71:531-556.
- Augustine, D. J., and S. J. McNaughton. 1998. Ungulate effects on the functional species composition of plant

- communities: Herbivore selectivity and plant tolerance. *Journal of Wildlife Management* 62:1165-1183.
- Autenrieth, R. E. 1981. Sage grouse management in Idaho. Project W-125-R and W-160-R. Idaho Department of Fish and Game, Boise, Idaho, USA.
- Barnett, J. K. and J. A. Crawford. 1994. Pre-laying nutrition of sage grouse hens in Oregon. *Journal of Range Management* 47:114-118.
- Beck, J. L. and D. L. Mitchell. 2000. Influences of livestock grazing on sage grouse habitat. *Wildlife Society Bulletin* 28:993-1002.
- Belnap, J., J. H. Kaltenenecker, R. Rosentreter, J. Williams, S. Leonard, D. Eldredge. 2001. Biological soil crusts: ecology and management. Technical Reference 1730-2, USDI Bureau of Land Management and U.S. Geological Survey.
- Berry, J. D., and R. L. Eng. 1985. Interseasonal movements and fidelity to seasonal use areas by female sage grouse. *Journal of Wildlife Management* 49:237-240.
- Blus, L. J., C. S. Staley, C. J. Henny, G. W. Pendleton, T. H. Craig, E. H. Craig, and D. K. Halford. 1989. Effects of organophosphorus insecticides on sage grouse in southeastern Idaho. *Journal of Wildlife Management* 53:1139-1146.
- Borell, A.E. 1939. Telephone wires fatal to Sage Grouse. *Condor* 41:85-86.
- Braun, C. E. 1986. Changes in sage grouse lek counts with advent of surface coal mining. *Issues and Technology in the Management of Impacted Western Wildlife* 2:227-231.
- ))))). 1998. Sage grouse declines in western North America: what are the problems. *Proceedings of the Western Association of State Fish and Wildlife Agencies* 78:139-156.
- Bunting, S. B., J. L. Kingery, M. A. Hemstrom, M. A. Schroeder, R. A. Gravenmier, and W. J. Hann. 2002. Altered rangeland ecosystems in the Interior Columbia Basin. USDA Forest Service General Technical Report PWN-553, Portland, Oregon, USA.
- Call, M. W., and C. Maser. 1985. Wildlife habitats in managed rangelands-The Great Basin of southeastern Oregon-sage grouse. USDA Forest Service General Technical Report PNW-187, Portland, Oregon, USA.
- Coggins, K. A. 1998. Sage grouse habitat use during the breeding season on Hart Mountain National Antelope Refuge. Thesis, Oregon State University, Corvallis, Oregon, USA.
- Connelly, J. W., and C. E. Braun. 1997. Long-term changes in sage grouse *Centrocercus urophasianus* populations in western North America. *Wildlife Biology* 3/4:123-128.
- ))))), Jr, H. W. Browsers, and R. J. Gates. 1988. Seasonal movements of sage grouse in southeastern Idaho. *Journal of Wildlife Management* 52:116-122.
- ))))), M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage grouse populations and their habitats. *Wildlife Society Bulletin* 28:967-985.
- ))))), W. L. Wakkinen, A. D. Apa, and K. P. Reese. 1991. Sage grouse use of nest sites in southeastern Idaho. *Journal of Wildlife Management* 55:521-524.

- Crawford, J. A., and A. K. DeLong. 1993. Relationships between vegetative structure and predation rates of artificial sage grouse nests. Final Report. Oregon State University, Corvallis, Oregon, USA.
- Dalke, P. D., D. B. Pyrah, D. L. Stanton, J. E. Crawford, and E. F. Schlatterer. 1963. Ecology, productivity, and management of sage grouse in Idaho. *Journal of Wildlife Management* 27:811-841.
- Daubenmire, R. F. 1940. Plant succession due to overgrazing in the *Agropyron* bunchgrass prairie of southeastern Washington. *Ecology* 21:55-64.
- Dobler, F. C., J. Eby, C. Perry, S. Richardson, and M. Vander Haegen. 1996. Status of Washington's shrub-steppe ecosystem: extent, ownership, and wildlife/vegetation relationships. Phase One Completion Report, Washington Department of Fish and Wildlife, Olympia, WA, USA.
- Drut, M. S., W. H. Pyle, and J. A. Crawford. 1994. Technical note: Diets and food selection of sage grouse chicks in Oregon. *Journal of Range Management* 47:90-93.
- Eberhardt, L. E., and L. A. Hofmann. 1991. Sage grouse on the Yakima Training Center: A summary of studies conducted during 1989 and 1990. U.S. Department of the Army, U.S. Department of Energy, and Pacific Northwest Laboratories, Yakima, Washington, USA.
- Emmons, S. R., and C. E. Braun. 1984. Lek attendance of male sage grouse. *Journal of Wildlife Management* 48:1023-1028.
- Eng, R. L., and P. Schladweiler. 1972. Sage grouse winter movements and habitat use in central Montana. *Journal of Wildlife Management* 36:141-146.
- Fischer, R. A., A. D. Apa, W. L. Wakkinen, K. P. Reese, and J. W. Connelly. 1993. Nesting-area fidelity of sage grouse in southeastern Idaho. *Condor* 95:1038-1041.
- ))))), K. P. Reese, J. W. Connelly. 1996. Influence of vegetal moisture content and nest fate on timing of female sage grouse migration. *Condor* 98:868-872.
- Galt, D., F. Molinar, J. Navarro, J. Joseph, and J. Holechek. 2000. Grazing capacity and stocking rate. *Rangelands* 22(6):7-11.
- Gibson, R. M. 1996. A re-evaluation of hotspot settlement in lekking sage grouse. *Animal Behavior* 52:993-1005.
- Gray, G. M. 1967. An ecological study of sage grouse broods with reference to nesting, movements, food habits and sagebrush strip-spraying in the Medicine Lodge Drainage, Clark County, Idaho. Thesis, University of Idaho, Moscow, Idaho, USA.
- Gregg, M. A. 1991. Use and selection of nesting habitat by sage grouse in Oregon. Thesis, Oregon State University, Corvallis, Oregon, USA.
- ))))), J. A. Crawford, and M. S. Drut, and A. K. DeLong. 1994. Vegetational cover and predation of sage grouse nests in Oregon. *Journal of Wildlife Management* 58:162-166.
- Hays, D. W., M. J. Tirhi, and D. W. Stinson. 1998. Washington State status report for the sage grouse. Washington Department of Fish and Wildlife, Olympia, Washington, USA.
- Hironaka, M., M. A. Fosberg, and A. H. Winward. 1983. Sagebrush-grass habitat types of southern Idaho. Idaho Forest, Wildlife and Range Experiment Station, Bulletin 35, Moscow, Idaho, USA.

- Hofmann, L. A. 1991. The western sage grouse (*Centrocercus urophasianus*) on the Yakima Training Center in central Washington: a case study of a declining species and the military. Thesis, Central Washington University, Ellensburg, Washington, USA.
- Holechek, J. L., H. Gomez, F. Molinar, and D. Galt. 1999. Grazing studies: what we've learned. *Rangelands* 21(2):12-16.
- ))))), D. Galt, J. Joseph, J. Navarro, G. Kumalo, F. Molinar, and M. Thomas. 2003. Moderate and light cattle grazing effects on Chihuahuan desert rangelands. *Journal of Range Management* 56:133-139.
- Jacobson, J. E., and M. C. Snyder. 2000. Shrubsteppe mapping of eastern Washington using Landsat Satellite Thematic Mapper data. Washington Department of Fish and Wildlife, Olympia, Washington, USA.
- Johnson, G. D., and M. S. Boyce. 1990. Feeding trials with insects in the diet of sage grouse chicks. *Journal of Wildlife Management* 54:89-91.
- ))))), and )))))). 1991. Survival, growth, and reproduction of captive-reared sage grouse. *Wildlife Society Bulletin* 19:88-93.
- Klebenow, D. A. 1969. Sage grouse nesting and brood habitat in Idaho. *Journal of Wildlife Management* 33:649-662.
- ))))). 1972. The habitat requirements of sage grouse and the role of fire in management. *Proceedings of the Annual Tall Timbers Fire Ecology Conference* 12:305-315.
- ))))). 1981. Livestock grazing interactions with sage grouse. Pages 113-123 *In* J. M. Peek and P. D. Dalke, editors. Wildlife-livestock relationships symposium: Proceedings 10. Forest Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho, USA.
- ))))). 1985. Habitat management for sage grouse in Nevada. *World Pheasant Association* 10:34-46.
- ))))), and G. M. Gray. 1968. Food habits of juvenile sage grouse. *Journal of Range Management* 21:80-83.
- Klott, J. H., and F. G. Lindzey. 1990. Brood habitat of sympatric sage grouse and Columbian sharp-tailed grouse in Wyoming. *Journal of Wildlife Management* 54:84-88.
- Livingston, M. F., and P. Nyland. 2002. Sage grouse breeding, distribution, and habitat use: Yakima Training Center 1999-2001. Yakima Training Center, Yakima, Washington, USA.
- Lyman, R. L., and S. Wolverton. 2002. The late pre-historic-early historic game sink in the northwestern United States. *Conservation Biology* 16:73-85.
- Mack, R. N., and J. N. Thompson. 1982. Evolution in steppe with few large, hooved mammals. *American Naturalist* 119:757-773.
- McArthur, E. D., A. C. Blauer, and S. C. Sanderson. 1988. Mule deer-induced mortality of mountain big sagebrush. *Journal of Range Management* 41:114-117.
- Myers, O. B. 1992. Sage grouse habitat enhancement: effects of sagebrush fertilization. Thesis, Colorado State University, Fort Collins, Colorado, USA.
- Oakleaf, R. J. 1971. The relationship of sage grouse to upland meadows in Nevada. Project W-48-2, Study R-VII, Job 7.1,2,3.

Nevada Department of Wildlife, Reno, Nevada, USA.

- Opperman, J. J., and A. M. Merenlender. 2000. Deer herbivory as an ecological constraint to restoration of degraded riparian corridors. *Restoration Ecology* 8:41-47.
- Peterson, J. G. 1970. The food habits and summer distribution of juvenile sage grouse in central Montana. *Journal of Wildlife Management* 34:147-155.
- Petersen, B. E. 1980. Breeding and nesting ecology of female sage grouse in North Park, Colorado. Thesis, Colorado State University, Fort Collins, Colorado, USA.
- Pyle, W. H., and J. A. Crawford. 1996. Availability of foods of sage grouse chicks following prescribed burning in sagebrush-bitterbrush. *Journal of Range Management* 49:320-324.
- Remington, T. E. 1983. Food selection, nutrition, and energy reserves of sage grouse during winter, North Park, Colorado. Thesis, Colorado State University, Fort Collins, Colorado, USA.
- ))))), and C. E. Braun. 1985. Sage grouse food selection in winter, North Park, Colorado. *Journal of Wildlife Management* 49:1055-1061.
- ))))), and )))))). 1991. How surface coal mining affects sage grouse, North Park, Colorado. *Issues and Technology in the Management of Impacted Western Wildlife* 5:128-132.
- Roberson, J. A. 1984. Sage grouse-sagebrush relationships: a review. Pages 157-167 in *Biology of Artemisia and Chrysothamnus*, Provo, Utah, USA.
- Robertson, M. D. 1991. Winter ecology of migratory sage grouse and associated effects of prescribed fire in southeastern Idaho. Thesis, University of Idaho, Moscow, USA.
- Schroeder, M. A. 1994. Movement and habitat use of sage grouse in north-central Washington. Progress Report, Washington Department of Fish and Wildlife, Olympia, Washington, USA.
- ))))). 1995. Productivity and Habitat Use of Sage Grouse in North-central Washington. Upland Bird Research, Job Progress Report, Washington Department of Fish and Wildlife, Olympia, Washington, USA.
- ))))), and R. K. Baydack. 2001. Predation and the management of prairie grouse. *Wildlife Society Bulletin* 29:24-32.
- ))))), D. W. Hays, M. F. Livingston, L. E. Stream, J. E. Jacobson, and D. J. Pierce. 2000. Changes in the distribution and abundance of sage grouse in Washington. *Northwestern Naturalist* 81:104-112.
- ))))), J. R. Young, and C. E. Braun. 1999. Sage grouse (*Centrocercus urophasianus*). Number 425 in A. Poole and F. Gill, editors, *The birds of North America*. Academy of National Science and American Ornithologists' Union, Philadelphia, Pennsylvania, USA.
- Singer, F. J., and R. A. Renkin. 1995. Effects of browsing by native ungulates on the sagebrush communities in Yellowstone National Park. *Great Basin Naturalist* 55:201-212.
- Stinson, E. R. and P. T. Bromley. 1991. Pesticides and wildlife: a guide to reducing impacts on animals and their habitat. Virginia Department of Game and Inland Fisheries, Richmond, Virginia, USA.
- Sveum, C. M. 1995. Habitat selection by sage grouse hens during the breeding season in south-central Washington. Thesis,

Oregon State University, Corvallis, Oregon, USA.

- ))))), W. D. Edge, and J. A. Crawford. 1998a. Nesting habitat selection by sage grouse in south-central Washington. *Journal of Range Management* 51:265-269.
- ))))), J. A. Crawford, and W. D. Edge. 1998b. Use and selection of brood-rearing habitat by sage grouse in south central Washington. *Great Basin Naturalist* 58:344-351.
- Swenson, J. E., C. A. Simmons, and C. D. Eustace. 1987. Decrease of sage grouse *Centrocercus urophasianus* after ploughing of sagebrush steppe. *Biological Conservation* 41:125-132.
- Tisdale, E. W., and M. Hironaka. 1981. The sagebrush-grass region: a review of the ecological literature. Idaho Forest, Wildlife, and Range Experiment Station, Bulletin 33, Moscow, Idaho, USA.
- U.S. Fish and Wildlife Service. 2003. Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines. [available at: <http://www.fws.gov/r9dhcbfa/windenergy.html>], Washington, D.C. USA.
- Wakkinen, W. L., K. P. Reese, and J. W. Connelly. 1992. Sage grouse nest locations in relation to leks. *Journal of Wildlife Management* 56:381-383.
- Wallestad, R. O. 1975. Life history and habitat requirements of sage grouse in central Montana. Montana Department of Fish and Game, Helena, Montana, USA.
- ))))), J. G. Peterson, and R. L. Eng. 1975. Foods of adult sage grouse in central Montana. *Journal of Wildlife Management* 39:628-630.
- ))))), and D. Pyrah. 1974. Movement and nesting of sage grouse hens in central Montana. *Journal of Wildlife Management* 38:630-633.
- ))))), and P. Schladweiler. 1974. Breeding season movements and habitat selection of male sage grouse. *Journal of Wildlife Management* 38:634-637.
- Wambolt, C. L., A. J. Harp, B. L. Welch, N. Shaw, J. W. Connelly, K. P. Reese, C. E. Braun, D. A. Klebenow, E. D. McArthur, J. G. Thompson, L. A. Torell, J. A. Tanaka. 2002. Conservation of greater sage-grouse on public lands in the western U.S.: implications of recovery and management policies. PACWPL-Policy Paper SG-02-02. Policy Analysis Center for Western Public Lands, Caldwell, Idaho, USA
- Warren, C. 2001. Endangered and threatened wildlife and plants; 12-month finding for a petition to list the Washington population of western sage grouse (*Centrocercus urophasianus phaios*). *Federal Register* 66:22984-22994.
- Washington Department of Fish and Wildlife. 1995. Washington state management plan for sage grouse. Washington Department of Fish and Wildlife, Olympia, Washington, USA.
- Welch, B. L., J. C. Pederson, and R. L. Rodriguez. 1988. Selection of big sagebrush by sage grouse. *Great Basin Naturalist* 48:274-279.
- ))))), F. J. Wagstaff, and J. A. Roberson. 1991. Preference of wintering sage grouse for big sagebrush. *Journal of Range Management* 44:462-465.
- Vander Haegen, W. M., F. C. Dobler, and D. J. Pierce. 2000. Shrubsteppe bird response to habitat and landscape variables in eastern Washington, USA. *Conservation Biology* 14:1145-1160.



- Yocom, C. N. 1956. The sage hen in Washington state. *Auk* 73:540-550.
- Young, J. R., C. E. Braun, S. J. Oyler-McCance, J. W. Hupp, and T. W. Quinn. 2000. A new species of sage-grouse (Phasianidae: *Centrocercus*) from southwestern Colorado. *Wilson Bulletin* 112:445-453.
- Young, J. A., and W. S. Longland. 1996. Impact of alien plants on Great Basin rangeland. *Weed Technology* 10:384-391.
- Zwikel, F. C., and M. A. Schroeder. 2003. Grouse of the Lewis and Clark expedition. *Northwestern Naturalist* 84:1-19.

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## KEY POINTS

### Habitat Requirements

- Sage-grouse depend on sagebrush for food and cover. Big sagebrush is a predominant species in sage-grouse habitat.
- During spring, males congregate on display sites (leks) to breed with females. Leks are typically located in open areas near relatively dense stands of sagebrush used for food and escape cover.
- Sage-grouse commonly nest in habitat containing sagebrush approximately 30-80 cm (12-31 in) in height, and relatively tall, dense herbaceous cover.
- Broods require an abundance of insects and forbs and often use wet meadows, irrigated farmland and areas at higher elevations.
- Sage-grouse winter in relatively dense sagebrush. Good wintering areas are found at a variety of elevations, and include windswept ridges and sagebrush flats.
- Adult sage-grouse feed almost entirely on sagebrush and forbs year-round. Forbs are consumed in spring, summer and early autumn. Insects and forbs are a critical food source to chicks.

### Management Recommendations

- Conversion of shrub-steppe habitat is strongly discouraged.
- Removal or alteration of sagebrush is discouraged within sage-grouse management areas, particularly near leks and in nesting and wintering areas. Sagebrush should not be removed within 300 m (984 ft) of sage-grouse foraging areas along riparian areas, meadows, lake beds, and farmlands.
- Sagebrush removal should not occur where live sagebrush cover is <25% in nesting areas, and <30% in wintering areas, on slopes >20% and/or on slopes with shallow soils where big sagebrush is <30 cm (12 in) in height.
- Prescribed fires should be # 50 ha in size and cover less than 20% of an area used by sage grouse during winter within any 20–30 year interval (depending on estimated recovery time for the sagebrush habitat). Because the availability of critical wintering habitat is likely the most significant limiting influence on sage-grouse, any burning conducted in wintering habitat should only be done with extreme caution as a means to restore habitat, and only very small portions of wintering habitat should be burned during any given

season. Avoid using fire where increase of or invasion by cheatgrass is likely.

- Develop grazing management plans based on the vegetation characteristics of sage-grouse breeding, brood-rearing, and winter habitats (see Table 1).
- Grazing in sage-grouse breeding, brood-rearing, and winter habitats should be light enough to promote long-term sustainability of habitat and stocking rates should be reduced during drought.
- Dramatically reduce or cease all grazing for a long time period when site is degraded by over-grazing to allow recovery of the native plant community. The cessation of grazing alone will likely not restore sites that have been completely overtaken by annual species.
- Insecticides should not be applied to sage-grouse summer habitat. Organophosphorus and carbamate insecticides are especially toxic.
- Use integrated pest management techniques within sage-grouse management areas.
- Minimize human disturbances from mid-February through early June within breeding and nesting areas. Restrict activity on roads traversing sage-grouse leks during hours when birds are active during lek season.
- Avoid building powerlines, wind turbines and other tall structures within 3 km (1.9 mi) of grouse habitat or within 8 km (5 miles) of leks. Fences should be constructed or modified in a manner that will reduce associated mortality.
- Support agricultural set-aside programs (such as the Conservation Reserve Program and the Wetlands Reserve Program) in sage-grouse management areas. Set-aside conservation programs should be structured to encourage enrollees to plant a diverse range of perennial shrubs, grasses, and forbs and to retain annual residual cover.